CoSSIR (Conical Scanning Submillimeter-wave Imaging Radiometer)

Center Frequency (GHz)	Bandwidth (MHz)	NE□T for □=100 ms @ 200K (K)	Beamwidth (degrees)	Polarization
183.31±1	500	0.22	4	H
183.31±3	1000	0.15	4	H
183.31±6.6	1500	0.13	4	H
220	3000	0.09	4	H
380±0.8	700	0.43	4	H
380±1.8	1000	0.32	4	H
380±3.3	1700	0.24	4	H
380±6.2	3600	0.17	4	H
487±0.7	400	0.71	4	H and V
487±1.2	900	0.44	4	H and V
487±3.3	3000	0.26	4	H and V
640	3000	0.26	4	H

CoSSIR is a new airborne total-power microwave radiometer that is designed to measure cirrus cloud parameters (IWP, the ice water path, and D_{me}, the median mass diameter of ice crystals) and water vapor profiles (between 0-12 km altitudes). The CoSSIR's widely separated groups of frequencies at 183.3, 220, 380, 487, and 640 GHz (see table above) are well suited for the retrievals of D_{me} and IWP of cirrus clouds. The dual polarization capability at 487 GHz has the potential of inferring the shape of ice particles. Based on the results of recent MIR observations (89-340 GHz), CoSSIR will undoubtedly extend the cirrus measurement capability to the regime where a direct comparison with visible/IR technique becomes possible.

The instrument has fifteen channels; nine of them at the frequencies of 183.3±1, 183.3±3, 183.3±6.6, 220, 380±0.8, 380±1.8, 380±3.3, 380±6.2, and 640 GHz are horizontally polarized, and the remaining six are dual-polarized at three frequencies of 487±0.7, 487±1.2, and 487±3.3 GHz. A scan head that contains the radiometers, power conditioning circuitry, and data digitization system is mounted to computer-controlled dual-axes gimbals. The scan geometry (e.g., conical or across-track) of CoSMIR is software programmable and can be designed to serve the scientific requirements of CRYSTAL-FACE. To match with the image to be obtained by the MAS onboard the same aircraft, CoSSIR is programmed to scan across-track over an angular swath of about ±54°. In addition to the Earth's scene, the instrument also views both hot and cold calibration targets once during each 5-sec scan cycle. The beam width for each channel is about 4°; at 20-km ER-2 cruising altitude, the ground resolution is about 1.5 km at nadir. Two closed-coupled external blackbody calibration references at temperatures of ~ 250 K and ~ 330 K provide precision calibration of the radiometric measurements. The temperature sensitivity of the instrument with 100 ms integration time is ≤ 0.7 K at all channels and the calibration accuracy is about ±0.7 K in the brightness temperature range of 200-300 K. This suggests that the accuracy of brightness depression is on the order of 1 K, and the threshold of IWP detection for particles with D_{me} ~ 100 μm will be as low as ~10 g/m^2 and ~5 g/m^2 at 487 and 640 GHz, respectively. For water vapor profiling based on the 8-channel measurements between 183-380 GHz, a simulation study gives an estimation of retrieval accuracy of about 5-15% in terms of relative humidity, depending on the retrieved value height.